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The Machine-building Industry of Shanghai
Chi-chiek Chih-tsao, Chen Wang-lung,
Shanghai, 15 March 1950

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RESTRICTED**SHANGHAI'S MACHINE-BUILDING INDUSTRY**

By Chen Wang-lung

Shanghai started to build up its machine-building industry along with its general commerce earlier than any other place in China. Its machine-building industry, which is now more than 80 years old, has a very good foundation; its production capacity is greater than elsewhere in China. At present it consists of 1,500 machine-building plants which have 20,000 units of machine tools and employ about 50,000 persons; its output constitutes more than one third of the machines produced in China. Obviously it is an important duty to study how to utilize the machine-building facilities in Shanghai in order to further nationwide economic reconstruction.

I. TWENTY THOUSAND MACHINE TOOLS

According to estimates made by the Machine Manufacturers Association, Shanghai has about 20,000 units of machine tools scattered in more than 1,000 State and private plants. Machine tools owned by State plants are relatively new and better; they constitute 10 percent of the total. Equipment owned by private plants is not as new and this equipment is poorly distributed. Some of it does not constitute complete units; (for example, some plants have lathes but no planers), hence the productivity of these plants is relatively low.

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MACHINE TOOLS OWNED BY SHANGHAI STATE AND PRIVATE PLANTS

	<u>State Plants</u>	<u>Private Plants</u> (Members of the Machine Manufacturers' Association)
Lathes	1,029	6,000
Bullard Mult-au-matic lathes		1,100
Planing machines	227	280
Drilling machines	271	1,700
Milling machines	265	680
Grinding machines	156	280
Slotting machines	25 (Approximately)	750
Shapers	20 (Approximately)	70
Boring machines	15 (Approximately)	45
Others	1,020	2,400
Unclassified machine tools (Lathes, planers, drills, etc)	391	
Total	3,419	14,305

Note: Data on machine tools owned by State plants are obtained from government sources; those owned by private plants which are members of the Machine Manufacturers Association are obtained from the association.

The total number of machine tools owned by state-owned and privately-owned plants is given as 17,924 units in the above table. If the machine tools owned by non-members of the trade association,

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such as those belonging to the textile, power, and communication companies, and machine shops of other industrial plants, including repair shops, are added, the machine tools in Shanghai total more than 20,000 units.

METALLURGICAL AND SMELTING FACILITIES IN SHANGHAI

On the basis of machine-building facilities, it is estimated that Shanghai also has a fairly large number of metallurgical and smelting facilities; however, Shanghai produces no coal and iron ore; it obtains coal and iron from other areas.

There are six steel companies in Shanghai: the Shanghai, the Asia, the Ta-chin, Jih-ya, Chung-chi, Ta-lung companies. These companies have equipment as follows: one 15-ton Martin furnace, two 10-ton Martin furnaces, one $1\frac{1}{2}$ -ton Bessemer hearth, three one-ton Bessemer hearth furnaces, three 3-ton electric furnaces, one 2-ton electric furnace, and two one-ton electric furnaces. Monthly production includes about 3,000 metric tons of steel ingots, 80-500 tons of cast steel, 50 tons of steel alloys, and about 30 tons of manganese steel (70 percent manganese). There are 20 additional steel plants equipped with 176 steel mills producing 5,000 to 9,000 tons of steel, (According to the Steel Manufacturers Association.)

There are 260 metal-casting plants in addition to the molding shops attached to the large machine-building plants. Most of these casting plants are on a small scale with less than 50 workers in each plant. Only three of the plants have

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50 to 100 workers each. Seven-tenths of these casting plants are equipped with shaft furnaces manufacturing products under 1,000 pounds in weight, the remaining three-tenths with the 16" to 32" 3-stage furnaces which can handle large-size objects. The state-owned Hung-kiang Machine-building Plant, Wu-sung Machine-building Plant, the General Machine-building Plant, the China Textile-Machine-building Plant, the Chill Casting Machine Parts Company, and the privately-owned Shanghai Machine-building Plant are equipped with Cupola furnaces.

According to estimates made by the association, the above plants, specializing in foundry work, produced monthly, before the currency reform in 1948 under the former regime, various moulded items amounting to 3,000 to 3,500 tons while the maximum capacity was 5,000 tons. Three-fourths of the products are machine parts, and one-fourth are pipes and other items used in water supply and sanitation works.

Other metal-casting plants which are also members of the molding Trade Association include 31 copper casting plants with a monthly output of 60 tons, and seven aluminum casting plants with a monthly output of 20 tons (mostly dies for rubber plants and table utensils). Production of these two sets of metal-casting plants may be seen from the following table.

	<u>Copper-casting plants</u> (Monthly)	<u>Aluminum-casting plants</u> (Monthly)
	Tons	Tons
Normal output	100	40
Present output	60	20
Potential output	150	80

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All the iron, copper, and aluminum casting plants in Shanghai had in December 1949 a total of 1,100 horse-power according to the foundry trade association; however, it is estimated that in normal time they have approximately 3,000 horse-power not including smelting shops attached to other industrial plants.

Some metal working plants are independent firms while others are affiliated with large industrial plants. Six metal fabricating plants -- Yu-yi-chang, Wang-chang-chih, Hu-hsiang-chih, Yang-heng-shun, Shun-Tai, and Hua-hing -- are equipped with hammers operated by steam engine or air compressor; they have a total of eight steam hammers of one-ton capacity or less, and three air-hammers of 500-pound capacity each or less. These six companies have 250 workers and a monthly production of about 5 to 40 tons, varying according to the size of the orders. They can produce spindles up to 12-inches in diameter and cog-wheels of 14 to 18-inches in diameter. The remaining 300 plants employ about 1,500 workers, not including workers hired for extra works. The products of these 300 plants are mostly small machine parts such as bolts used in rails, vehicles, furnaces, and boilers. Monthly output of bolts and machine parts before the liberation of Shanghai amounted to about 500 tons.

Most of the metal shops which are affiliated to various industrial plants have not joined the Metalworkers Trade Association. Among them the Wu-hsung Plant, Hung-kiang Plant, the Shanghai Power Company, the China Ship Building Company, the Ying-lien Ship Building Company, the Chiao-hing Company are equipped

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with steam or air hammers, the largest of which is of one-ton capacity. Output of these plants amounts to 200 tons monthly. The General Machine-Building Plant has also been equipped with steam hammers which will start operation soon.

About 60 plants specialize in producing engines, with yearly output of 200 or more 200- to 300 horsepower engines, or 60,000 horsepower in total. There are about 500 shops specialized in welding scattered everywhere in Shanghai. These shops repair air-conditioning machines, bicycles, charcoal burners or oil burners used in automobiles. There are dozens of plants working on various metals not mentioned above, such as nickel, tin, zinc, chromium, etc.

III. 50,000 TECHNICAL WORKERS AND 60,000 TONS OF MACHINE OUTPUT

According to the Industry Division of the East China Military and Political Control Committee, Shanghai's machine-building industry has 49,720 technical workers distributed as follows:

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	<u>Machine Building</u>	<u>Metal Fabricating</u>	<u>Metal Casting</u>	<u>Metallurgy</u>	<u>Shipbuilding</u> <u>State</u>	<u>Private</u>	<u>Bicycles</u>
Skilled workers	14,109	1,514	1,999	3,307	6,328	1,095	1,420
Apprentices	7,118	1,596	1,069	4,274	101	393	
Employees	3,100	682	125	313	566	341	171

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In the above table metal fabricating refers to the manufacturing of machine parts made of iron, such as screws and bolts; metal casting refers to manufacturing of metal parts for use in building, sewage construction, textile machinery, aluminum articles, etc. Subtracting these from the above figures on technical workers, there remain 44,422 persons who directly participate in machine-building: they constitute 40 percent of the total technical personnel in China. From this angle, one can see that Shanghai's machine-building industry is going to play an important role in the national reconstruction program.

According to statistics compiled by government and trade associations for the respective industry, the normal yearly production of Shanghai's machine-building industry is as follows:

<u>Industry</u>	<u>Items</u>	<u>Normal Yearly Production</u>
(1)	(2)	(3)
Machine-Building	1. Machine tools	1,200 units
(Including	2. Motors	25,000 horsepower internal combustion heat engines, 60,000 horsepower
shipbuilding)	3. Construction machines	3,000 units
	4. Ships	30,000 metric tons (Each ship 1,000 tons)
	5. Ships repaired	840,000 tons (Each ship ranging from a few hundred tons to 6,000 tons)
	6. Cotton spindles	50,000
	7. Weaving mills	7,000 units
	8. Sewing machines	Manual, 15,000 Motorized 9,000

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(1)	(2)	(3)
Casting	Metal castings	42,000 tons (according to trade associations)
Metal works	metal parts used in construction, sewage, textile machines and aluminum utensils, etc.	2,000 tons (In addition, automobile parts for 18,000 automobiles)
Iron works	Castings, screws, nails,	15,000 - 20,000 tons
Bicycles	Bicycles and parts	200,000

Motors mentioned in the above table include various steam and internal combustion engines. On the basis of present facilities, Shanghai can produce steamship engines totalling thousands of horsepower. This is not including in this tabulation. Thus the actual horsepower capacity of Shanghai's machine-building industry is greater than our estimate here.

Shanghai's machine-building plants have good experience in producing textile machinery; their maximum yearly production can reach 80,000 spindles, and 10,000 weaving mills.

Metal and iron castings plus the steel-alloys constitute the gross weight of finished machinery. According to estimates made by the Trade Association, Shanghai consumes 10,000 tons and more of various steel-alloys. If the machinery's weight is 80

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percent of the consumed metals, Shanghai can produce annually machines amounting to about 60,000 tons net. This can be further increased if work is well coordinated and workers' enthusiasm is raised.

IV. TECHNICAL LEVEL IN SHANGHAI HIGHER THAN ELSEWHERE

Shanghai's 80-year old machine-building industry has acquired better technical know-how than anywhere else in China. This can be seen from its production techniques, equipment, facilities and products.

First, Shanghai's machine-building has succeeded in engineering its own production instead of copying from other countries as it did in the past. For instance, various motors have been converted to using wood or corn husks as fuels as a measure of coping with oil shortage; a gas diesel engine has been developed for reducing oil consumption (by almost 80 percent); an ignition mechanism based on pressure differential has been introduced to replace the foreign-made spark plug; and the design for a hydraulic engine of 7,000 horsepower for the hydroelectric plant in Ko-tien, Fu-kien Province, is under way. Mining machinery such as water pumps, exhaust fans, air compression machines, etc, ^{is} ~~are~~ produced in accordance with standard designs. The satisfactory engineering of the gear shaving machine by the Mechanical Engineering Section of the Industry Division of the East China Military and Political Control Committee also proves that Shanghai's machine-building industry is keeping up with

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the most modern technique.

Second, Shanghai's machine-building industry has acquired more advanced techniques due to its long history and accumulated experience. Some plants produce machine tools (such as grinding machines, turret lathes, multi-automatic planers, and others) which have the same degree of precision as imported machine tools. A few plants can produce now in small quantity the fuel pumps and spark plugs used in gasoline engines, which require very delicate skill. Furthermore, experimental plans have been made for making gage blocks used in testing.

Third, the Shanghai machine-building industry has adopted standardized measures and an inspection system. In addition to micrometer, dial indicator, and other instruments more specific in precision measures are used. Moreover, products are examined individually on the basis of tolerance; this has improved the quality of products and reduced the cost of machine assembling.

Fourth, some plants specialized in certain types of machines have been equipped with more and more new machine tools and mechanical instruments such as drilling jigs, fixtures, and other special toolings. Some large-scale plants have been equipped with machine tools such as radial grinding machines, horizontal grinding machines, centerless grinding machines, turret lathes, Gleason Bevel Gear Generators, honing machines, gear shapers, jig borers, etc.

Fifth, Shanghai's machine-building industry produces a

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wide variety of machines, some of which cannot be produced elsewhere; for instance, metal screens and textile mills manufactured by China Textile Company; cotton spinning mills by Tai-li, Ping-ho, Chen-fu companies and others; machine tools by Ming-chin, Chung-hua and Ta-tung companies, gasoline engines by Chung-hua Company, high-speed diesel engines by the New China Company; various water pumps, cranes and paper manufacturing machines by Chung-hua Company, cigarette manufacturing machines by the New China and Ying-chin companies, bicycles and bicycle chains by Shanghai Vehicle Manufacturing Company and the Hsin-sing Company; Automobile parts by the Pao-chan and Lo-pen-chan companies; sewing machines by the Hsieh-chan, Huai-king companies, precision instruments by Ting-feng, Hsing-hsing, and Pao-chuan companies. The following products also mark the advanced technique adopted by the casting industry in Shanghai: the wrought iron made by the Hua-feng Company, the chill castings by the Chill Casting Company, the experimental magnetic steel by the Asia Steel Mill, and the mechanite cast iron by the New China Company.

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V. LIFE LINE OF SHANGHAI'S MACHINE-BUILDING INDUSTRY

Shanghai's machine-building industry obtains raw materials and fuels entirely from outside, mainly Northeast and North China; this is a great problem of vital importance to Shanghai's machine-building industry. The following table shows the annual consumption of fuels and basic materials by Shanghai's machine-building industry (according to estimates of the trade associations):

Name of Material	Annual Consumption (in metric tons)
[1]	[2]
Pig iron	60,000 ⁽¹⁾
Round stock	2,400 net 24,000 gross
Square iron	1,200
Hectagonal iron	120
Triangle iron	3,600
Iron strip	1,200
I-beams	600
Fluid (汽水) iron	600
Sheet iron	6,000
Ferrous sheet	720
Ferrous tube	3,600 ⁽²⁾
Nonferrous tube	1,200
Bronze	3,600 ⁽³⁾
Brass	1,200 ⁽⁴⁾
Phosphor bronzes	36 ⁽⁵⁾

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[1]	[2]
Steel alloys	1,920 ⁽⁶⁾
Steel tape	240
Hard lead	300
Tin plate	240
Zinc	600
Nickel	60
Aluminum	480
Manganese	120
Lead	72
Silicon iron	240
Solder	3,600

Notes:

(1) Prior to the Sino-Japanese War Liu-ho-kou alone supplied Shanghai 13,600 metric tons of pig iron monthly.

(2) Including steel tube.

(3) and (4) Including copper wire, tube, sheet, and plate.

(5) Including copper plate, sheet, and wire.

(6) Including steel wire, steel rods, cast steel, etc.

As to fuel consumption, Shanghai's machine-building industry uses annually 20,000 to 30,000 tons of anthracite and bituminous coal, and thousands of tons of gasoline (not including oil used in power plants).

Most of the basic materials listed above are supplied by

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Northeast China and North China; tool steel, cast steel, steel tube, grinding wheel, Emery, carbide tools, steel bearings, etc., are being imported from abroad. Anthracite coal comes from Suchow and Chiao-tso, and bituminous coal comes mainly from Huai-nan Province.

VI. AN ANALYSIS OF THE DIFFICULTIES CONFRONTING SHANGHAI'S MACHINE-BUILDING INDUSTRY BEFORE AND AFTER THE LIBERATION

In the periods immediately preceding and following the liberation, many difficulties confronted Shanghai's machine-building industry. Industrial depression which hit Shanghai's industry at that time can be seen from industrial power consumption as follows: (According to data compiled by the Industry Division of the East China Military and Political Control Committee; unit: Kilowatts)

[See next page for table]

We can notice two things from the above table:

First, in 1947, a year in which industrial activities are considered rather normal for the period following the V-J Day, Shanghai's machine-building industry's power consumption reached 1,465,000 kilowatts monthly; but it had fallen to only 550,000 kilowatts beginning in 1949 by the time of the liberation, or one-third of the 1947 monthly consumption. This indicated that under the disastrous industrial policy of the Kuomintang and the resultant chaotic economic condition, the machine-building industry was heading for crisis.

Second, power consumption in the period shortly after the

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liberation, up to September 1949, showed an obvious increase as industrial production got on its way to recovery. However, it fell again after September to an amount even smaller than in the period preceding the liberation. This was because the campaign against bandits and various reforms were still under way in the countryside, which brought about production cutbacks. This was unavoidable, and we must overcome all the difficulties involved in this business cutback.

But it is important for us to recognize that the present difficulties encountered by us are basically different from those in the past:

First, China's manufacturing industry was in the past a victim of imperialist countries' commodity dumping.

Second, the reactionary regime did not give protection to the manufacturing industry; on the contrary, it took pleasure in purchasing imported goods. Consequently, Shanghai's machine-building industry remained an assembling industry.

Third, before the liberation, most of Shanghai's machine-building industry was controlled by imperialists and bureaucratic capitalists who strangled labor and management relations; consequently, labor disputes frequently occurred and production efficiency was lowered.

Fourth, during the economic chaos of the past, the value of money depreciated by the hour; speculators reaped excess profits while the legal national capitalists were exploited by usurious interests, confronted with higher costs and limited market, and

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finally many concerns went out of business.

These difficulties and the resultant business depressions constituted a vicious circle and became almost incurable.

Finally, Shanghai was liberated while it was at the midst of darkness. Shanghai's machine-building industry was saved from economic chaos and from the hands of the capitalists. The paralyzed labor-management relations became improved with increasing working enthusiasm displayed by the workers. The menace of capitalists' commodity dumping no longer existed. The government has drawn up definite plans for transforming the colonial, backward, and subservient industry into a specialized and self-sufficient industry. This means a lot to Shanghai's machine-building industry.

Insufficient market demand and shortage of raw materials are the main difficulties which confront the present Shanghai machine-building industry. But these difficulties are only temporary. Appropriation for economic reconstruction constitutes 23.9 percent of the total budget for this fiscal year. If one-third of this appropriation, or 3,000 billion people's yuan equivalent, is used to purchase machinery, there will be a huge demand for machinery, amounting to 200,000 metric tons. In other words, the machine-building industry faces heavy purchase order ahead. As to raw materials, they present no problem at all; the success in economic reconstruction in North and Northeast China will undoubtedly assure a sufficient supply of most of the raw materials used by the Shanghai's machine-building industry. All in all, the machine-building industry in Shanghai has a very hopeful future.

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VII. INDUSTRIAL COORDINATION AND SPECIALIZATION

From the above discussion, we can easily arrive at the following conclusions:

First, Shanghai's machine-building industry possesses one-third of the nation's machine tools; successful use of this solid foundation will certainly determine the economic future of all China.

Second, these machine tools owned by Shanghai's machine-building industry are scattered; they belong to 1,500 plants. Only 60 of these plants employ 100 or more workers; 1,400 plants have less than 100 workers each (according to data compiled by the Metalworkers Trade Association). In order to develop their potential productivity, it is essential to coordinate their production activities. We should put them at work efficiently as though they were an organic whole.

Third, in order to develop productivity fully, each plant must specialize; for instance, small-scale plants specialize in certain machine parts, or in certain phases of work in manufacturing machine parts, while large-scale plants specialize in engineering precision jobs and machine assembling. If industrial specialization is established, we can use the specific toolings more efficiently; workers can acquire greater skill; and technicians and engineers can concentrate on a limited area of study, thus making greater progress in technology. In short, specialization of labor is the one and only condition for high efficiency. But specialization must begin with coordination.

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Fourth, coordination can be realized only by having an overall plan and a responsible organization full of initiative. For the sake of expediency, we may divide the industrial concerns into groups or units by nature of work or by district. A plant having better facilities will be the group leader in charge of collective purchasing of raw materials, centralized inspection of the plants and their products, etc. Technical problems and work assignments will be discussed and worked out jointly by plants within the same group. Centralized inspection is an indispensable system for quality control and cost control; it can lead to an improvement in product quality if it is properly administered.

VIII. USE OF NEW PRODUCTION METHODS

The purpose of industrial coordination and specialization of labor is to utilize fully the production capacity which exists in Shanghai today. But we should go further than this: we should introduce new production techniques to replace the old ones on the basis of long run interest. In other words, we should transform our industry from a state of primitive production methods and low efficiency to one of high production methods and high efficiency. The course of action that we should take is as follows:

1. We should make a special effort to manufacture more machine tools, special cutting tools and attachments. We should produce more universal machine tools, such as turret lathes, automatic screw machines, multiple drilling head, face milling machines, boring machines, for finish cutting and rough cutting, hobbing machines, gear shapers, shaving machines, gear lapping machines, centerless grinding machines, heavy-cut lathes, broaching

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machines, etc., and special cutting tools for use in various machine tools.

2. We must exercise close control over the quality of raw materials and improve industrial heating facilities. Raw material control is a very important job in the modern production process. In the past the businessmen were interested only in profit and ignored quality control. The consequence was that some finished products did not last long in use. Henceforth, we should set up laboratories for making physical and chemical tests on industrial raw materials.

Heat treatment is also an important phase in the production process. We should purchase additional coal furnaces, heating, and quenching furnaces, heat-controlling devices, and high frequency furnaces. It seems worth while that one or two furnace manufacturing plants should be set up in Shanghai.

3. We should control the tolerances of machine parts and enforce the inspection system in order to achieve high efficiency in machine assembling.

4. We should introduce extensive use of various specialized cutting tools such as drilling jigs, fixtures, special tools, and others.

5. We should establish belt-line production methods after we have all the necessary machine tools and various specialized machines, as it is the most efficient method.

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RESTRICTED**IX. OBJECTIVES OF SHANGHAI'S MACHINE-BUILDING INDUSTRY**

Shanghai's machine-building industry is a powerful force in the production front because of its high technical level, 20,000 machine tools, 50,000 technical personnel, and its production of 60,000 tons of machines and machine parts. The first task for Shanghai's machine-building industry is to cooperate with the government in carrying out national economic reconstruction. The second task for Shanghai's machine-building industry, or the task for this year, is to help develop the nation's heavy industry and communications system such as transportation industry, mining, metallurgical industry and others. Its third task is to produce more and more machine tools since it is equipped with better precision machine tools and skilled workers. At present Shanghai's machine-building industry should produce a great number of electric generators to cope with the situation caused by the air attacks. In short, Shanghai's machine-building industry should develop its great potential capacity in order to fulfill its proper role in nationwide economic reconstruction and in the present antiair-attack campaign.

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